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COMPLETE SPECIFICATION.

Improvements in Explosive Mixtures containing Chlorates or Perchlorates.

I, EDWARD CHARLES ROBERT MARKS, of 57—58, Lincoln's Inn Fields, London, W.C., Consulting Engineer, do hereby declare the nature of this invention (a communication from abroad from Pala Companhia Himalayite, of Praco do Municipio No. 19, Lisbon, Portugal) and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to chlorate explosives of the type containing potassium or other chlorates or perchlorates, a solid combustible body and a liquid or pasty combustible body.

10 The chlorates or perchlorates hitherto employed are salts of potassium, sodium, or of other metals or of ammonium.

The solid combustible bodies hitherto employed comprise starch or other amylaceous matter, for example, wheat, flour, cellulose, for example as sawdust, sugar, pitch or tar, solid carbon, for example, lampblack or anthracite, solid 15 hydrocarbons, for example, naphthalene or a nitro-derivative of a hydrocarbon. Liquid combustible bodies such as heavy mineral oil, vaseline, castor oil, drying oils, naphtha or benzine have been employed in the production of such explosives.

It has been proposed to produce explosives of this type containing from 0.02 20 to 5 *per cent.* of manganese dioxide, copper oxide or barium peroxide and in another case to employ from 0.5 to 40 *per cent.* of manganese dioxide.

According to the Specification of my Letters Patent No. 22,030 of A.D. 1910, it has been proposed to add a metal powder to the mixture in the process for manufacturing safety explosives containing one or more chlorates or perchlorates, 25 a solid combustible material and one or more oils, and it has been proposed to add, in addition, metallic oxides or dehydrated copper sulphate.

In carrying out this process pyrophoric iron or finely powdered magnesium or aluminium has been employed, the proportions of these ingredients to the whole being from 2 to 10 *per cent.* As detonating compounds one or more 30 metallic oxides have been employed, for example, ferric oxide or other oxide of iron, chromium, manganese, copper or barium, or else copper sulphate or other sulphates preferably dehydrated or roasted at a temperature not exceeding 300° C. the proportions of these ingredients to the whole being from 2 to 5 *per cent.*

35 The object of the present invention is to provide an improved explosive of the type referred to and of the class containing both a detonating compound and a pulverized oxidizable metal.

According to the invention, the proportion of detonating compound present in the explosive is less than 2 *per cent.*

40 The "solid combustible bodies" employed in the production of explosives according to the invention may be starch, inuline, cellulose, or, a substance

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containing these and other carbohydrates for example, sawdust meals or flours obtained from maize or Indian corn, the yam or sweet potato or from any root-stock, tuber, grain or the like rich in starch, anthracite or other coal, asphalt or pitch, or vegetable matter of any kind reduced to fine powder, for example, sugar, different species of gum, mucilage or the like.

The starch and the cellulose may be converted into dextrine, for instance for the purpose of facilitating the agglomeration of the mass with water so as to render easier the granulation of the explosive composition.

The "liquid combustible bodies" that it is preferable to use are: heavy mineral oil, all species of vegetable oil, including siccative oils, and oxidized vegetable oils.

These oils may be replaced by any oil or product resulting from the distillation of wood, petroleum, bituminous shale, and from tar, and even mineral wax and natural or mineral asphaltum.

The "metallic combustible elements" employed are, for example, pure aluminium or an aluminium alloy in the form of a powder, or finely powdered iron-carbide, ferro-silicon and the like.

The "detonating bodies" employed are: manganese dioxide, copper protoxide, permanganates or chromates of potassium, sodium or ammonium, or sulphur or sulphur compounds.

In order to indicate the proportions of the ingredients used in carrying the invention into effect, the following particulars are given by way of example.

(a)	Potassium chlorate	-	-	-	-	-	81	to	84%	
	Starch or its equivalent	-	-	-	-	-	8	to	15%	
	Mineral oil, vegetable oil or their mixtures	-	-	-	-	-	4	to	8%	25
	Metallic combustible element, for example,									
	aluminium	-	-	-	-	-	2	to	6%	
	Detonating bodies	-	-	-	-	-	less than		2%	
(b)	Potassium perchlorate or sodium chlorate	-	-	-	-	-	78	to	82%	
	Starch or its equivalent	-	-	-	-	-	11	to	19%	30
	Mineral oil, vegetable oil or its mixtures	-	-	-	-	-	3	to	7%	
	Metallic combustible element, for example,									
	aluminium	-	-	-	-	-	2	to	6%	
	Detonating bodies	-	-	-	-	-	less than		2%	
(c)	Ammonium chlorate or perchlorate, or sodium									35
	perchlorate or any mixture of same	-	-	-	-	-	76	to	80%	
	Starch, sawdust, or the like	-	-	-	-	-	12	to	21%	
	Mineral oil, vegetable oil, tar or their mixtures	-	-	-	-	-	3	to	8%	
	Metallic combustible element, for example,									
	aluminium	-	-	-	-	-	2	to	6%	40
	Detonating bodies	-	-	-	-	-	less than		2%	

When tar or pitch or asphalt or other bodies more or less pasty at the ordinary temperature are used as the liquid or pasty combustible, they can replace a part of the solid combustible, and their percentage may attain 13%.

The percentage of "detonating bodies" (manganese dioxide, and the like) employed is as already stated always less than 2%. When peroxides are employed they may replace an equivalent part of the oxidising salts.

The process of manufacturing this species of powder is as follows:

The chlorates, perchlorates or mixtures of chlorates and/or perchlorates are placed simultaneously or successively in a mixing apparatus, together with the mineral oil or its equivalent, starch or its equivalent being added to the mass.

The aluminium dust, the copper protoxide or manganese peroxide or their equivalents are added to the mass at any stage of the manufacture.

The mixture, after being well compounded is worked in suitable apparatus,

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until it becomes well combined, and preferably hardened and consequently dry, so that it does not spot the paper.

The mass is then granulated and made up into cartridges by the ordinary processes.

- 5 The mass can be pressed to render the granulation easier.

The mixture can be made with or without water, with any gum, with starch gelatinised by any process, before, during or after the mixture of the ingredients.

The water, when used, should not be more than 30% of the total weight of the mixture.

- 10 Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. Chlorate explosives of the type containing potassium chlorate or other chlorates or perchlorates, a solid combustible body, a liquid or pasty combustible body, an oxidizable metal and a detonating compound such as a metal oxide characterized in this that the proportion of detonating compound present in the explosive is less than 2 *per cent.*

2. Chlorate explosives as claimed in Claim 1 which contain 78—82 *per cent.* of chlorates or perchlorates, 8—15 *per cent.* of starch or an equivalent solid combustible, and 3 to 8 *per cent.* of heavy mineral or other oil.

- 20 3. Chlorate explosives as claimed in any of the preceding claims which contain in the form of a fine powder an aluminium alloy or iron carbide or ferro-silicon.

4. Chlorate explosives as claimed in any of the preceding claims which contain as detonating bodies permanganates or chromates of potassium, sodium or ammonium and the like or sulphur or sulphur compounds.

- 25 5. Chlorate explosives as claimed in Claims 1 or 2, in which the proportion of aluminium or other oxidizable metal present is from 2 to 8 *per cent.*

6. The improved chlorate explosives substantially as hereinbefore described.

- 30 Dated this 22nd day of December, 1913.

MARKS & CLERK.